



Massachusetts  
Department  
of  
ENVIRONMENTAL  
PROTECTION

## technical update

# Freshwater Sediment Screening Benchmarks for Use Under the Massachusetts Contingency Plan

Update to: Section 9.4 of *Guidance for Disposal Site Risk Characterization – In Support of the Massachusetts Contingency Plan* (1996)

## Use of Sediment Screening Criteria in a Stage I Environmental Risk Characterization

Under the Massachusetts Contingency Plan, 310 CMR 40.0995, Environmental Risk Characterization is required for all sites evaluated using Method 3, the site-specific risk assessment approach. The guidelines for conducting environmental risk characterizations are intended to be flexible, allowing the scope and level of effort of an assessment to be commensurate with the nature and complexity of the risks posed by the site.

The Stage I Environmental Screening is designed to enable site managers to determine relatively quickly and easily whether a more detailed (Stage II) environmental risk assessment is needed to evaluate a site. The Stage I Screening should (1) identify potential exposure pathways; (2) identify any *readily apparent harm*; (3) identify site conditions that exceed, or may exceed *effects-based screening criteria*. This Technical Update describes sediment screening benchmarks that may be used in the Stage I screening step. Additional guidance is available (MADEP, 1996) on conducting MCP Environmental Risk Characterizations.

## Summary of Previous Guidance

In 1996, DEP recommended the use lowest effect levels (LELs) from the Ontario Ministry of the Environment for screening risks to benthic organisms from freshwater sediment (section 9.4.2.3 of MADEP 1996). The LEL indicates a level of contamination below which no effects are expected on the majority of sediment-dwelling organisms.

The LEL was derived by Persaud et al. (1993) using field-based data on the co-occurrence of sediment concentrations and benthic species. The calculation of the LEL for a chemical is a two-step process. The screening level concentrations for each individual benthic species are calculated. The sediment concentrations at all locations at which that species was present are plotted in order of increasing concentrations. The 90<sup>th</sup> percentile was chosen as a conservative estimate of the tolerance range of species. In the second step, the 90<sup>th</sup> percentiles for all of the species are plotted, also in order of increasing concentration. From this plot, the 5<sup>th</sup> percentile is calculated and used as the LEL.

# Recommended Freshwater Sediment Screening Values

DEP has adopted the consensus-based threshold effect concentrations (TECs) for the 28 chemicals listed in MacDonald et al. (2000) for use in screening freshwater sediment for risk to benthic organisms. A list of these consensus-based TECs is provided in Table 1.

The threshold effect concentrations are intended to identify contaminant concentrations below which harmful effects on sediment-dwelling organisms are not expected. These concentrations may not necessarily be protective of higher trophic level organisms exposed to bioaccumulating chemicals. DEP has chosen the consensus-based TEC values because they incorporate a large data set, provide an estimate of central tendency that is not unduly affected by extreme values, and incorporate sediment quality guidelines that represent a number of approaches for developing sediment benchmarks.

**Table 1. Sediment quality guidelines for metals in freshwater ecosystems that reflect Threshold Effects Concentrations (TECs, i.e., concentrations below which harmful effects are unlikely to be observed)**

Consensus-Based		Consensus-Based	
Substance	TEC	Substance	TEC
<b>Metals</b>		<b>Organochlorine pesticides</b>	
(in mg/kg DW)		(in µg/kg DW)	
Arsenic	9.79	Chlordane	3.24
Cadmium	0.99	Dieidrin	1.90
Chromium	43.4	Sum DDD	4.88
Copper	31.6	Sum DDE	3.16
Lead	35.8	Sum DDT	4.16
Mercury	0.18	Total DDTs	5.28
Nickel	22.7	Endrin	2.22
Zinc	121	Heptachlor epoxide	2.47
		Lindane (gamma-BHC)	2.37
<b>Polychlorinated biphenyls</b>			
(in µg/kg DW)			
Total PCBs	59.8		
<b>Polycyclic aromatic hydrocarbons</b>			
(in µg/kg DW)			
Anthracene	57.2	Chrysene	166
Fluorene	77.4	Dibenz[a,h]anthracene	33.0
Naphthalene	176	Fluoranthene	423
Phenanthrene	204	Pyrene	195
Benz[a]anthracene	108	Total PAHs	1,610
Benzo(a)pyrene	150		

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**Comment:** July 7, 2003 – a typographical error has been corrected. The value for Total DDTs is correctly 5.28 µg/kg DW, not 5.23 as previously written.

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The consensus-based TEC incorporates the Ontario Ministry of the Environment lowest-observed effect levels (LELs) (Persaud et al 1993) as well as data from up to five other sediment quality guidelines (when available), including:

- threshold effects levels (TELs) (Smith et al. 1996),
- effects range-low (ER-L) values (Long and Morgan 1991),
- threshold effect levels for *Hyalella azteca* in 28 day tests (TEL-HA28) (U.S.EPA 1996a; Ingersoll et al. 1996),
- minimal effect thresholds (MET) from EC and MENVIQ (1992), and
- chronic equilibrium partitioning thresholds (SQAL) (Bolton et al. 1985; Zarba 1992; U.S.EPA 1997a).

Consensus-based TECs were calculated by determining the geometric mean of the sediment quality guidelines that were available for a chemical. Consensus-based TECs were calculated only if three or more published sediment quality guidelines were available for a chemical from the sources listed above.

## For Further Information

For further information about this Technical Update, contact Thomas Angus, Massachusetts Department of Environmental Protection, Office of Research and Standards, One Winter Street, Boston MA 02108. Telephone: (617) 292-5513, email: Thomas.Angus@state.ma.us.

## References

Bolton, S.H., R.J. Breteler, B.W. Vigon, J.A. Scanlon, and S.L. Clark. 1985. National Perspective on Sediment Quality. Prepared for the U.S. Environmental Protection Agency. Washington, D.C.

Environment Canada and Ministère de l'Environnement du Québec (EC MENVIQ). 1992. Interim Criteria for Quality Assessment of St. Lawrence River Sediment. Environment Canada, Ottawa.

Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, N.E. Kemble, D.R. Mount, and R.G. Fox. 1996. Calculation and evaluation of sediment effect concentrations for the amphipod *Chironomus riparius*. *Journal of Great Lakes Research* 22:602-623.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. *Archives of Environmental Contamination and Toxicology* 39: 20-31.

Massachusetts Department of Environmental Protection. 1996. Guidance for Disposal Site Risk Characterization Chapter 9 Method 3 Environmental Risk Characterization. Bureau of Waste Site Cleanup and Office of Research and Standards. April.

Persaud, D., R. Jaagumagi, and A. Hayton. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Water Resources Branch, Ontario Ministry of the Environment. Toronto.

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**Comment:** June 20, 2002 – A reference to Long and Morgan, 1991 was removed as the paper refers to marine sediments rather than the freshwater sediments that are the topic of this Technical Update. DEP regrets any possible confusion caused by the reference to marine sediment.

Smith, S.L., D.D. MacDonald, K.A. Keenleyside, C.G. Ingersoll, and J. Field. 1996. A preliminary evaluation of sediment quality assessment values for freshwater ecosystems. *Journal of Great Lakes Research* 22:624-638.

U.S. Environmental Protection Agency (U.S. EPA). 1996. Calculation and Evaluation of Sediment Effect Concentrations for the Amphipod *Hyaella azteca* and the Midge *Chironomus riparius*. Great Lakes National Program Office, Region V. Chicago, Illinois.

Zarba, C.S. 1992. Equilibrium partitioning approach. In: Sediment Classification Methods Compendium. EPA 823-R-92-006. Office of Water. U.S. Environmental Protection Agency. Washington, D.C.

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